National Energy Project

Agenda

- Introductions
- Context national
- Commercial
- Wind variability
- Hydro storage
- Collection network
- Transmission
- Interconnection
- Execution
- Q & A

Project Evolution

Spirit of Ireland

- Volunteer Organisation
- Professional Engineers
- Consultants
- Civil Contractors
- Equipment Manufacturers
- Social Movement

Natural Hydro Energy

- Incorporated Company
- Professional Management
- Advisory Board
- International Board
- Working capital
- External project finance
- Long term finance

A company has grown out of SoI - Natural Hydro Energy Ltd.
Objective is to transform wind energy from an intermittent and unreliable power source into Dispatchable, on-demand power - facilitate appropriate investment.

Irelands Potential

- With 6% of the renewable resources of the EU 27 (1% of population), Ireland has enormous potential wealth in terms of Natural Energy. Harvesting this power efficiently and quickly will deliver a sound basis for long term, secure economic growth and a stable, sustainable society.

- By combining fuel cost free wind with pumped hydro storage NHE is aiming to develop the world's first fully dispatchable, large scale "Natural Energy Power Station".

Natural Hydro Energy

Objective of this project

Large Scale Energy Wealth and Job Creation

in Ireland

by

Producing Carbon Free, Price Stable, Secure Power

Natural Energy Industry Framework

Five Components of Large Scale Energy Wealth Creation in Ireland

Technical	Commercial	Financial	Legal/Social	National

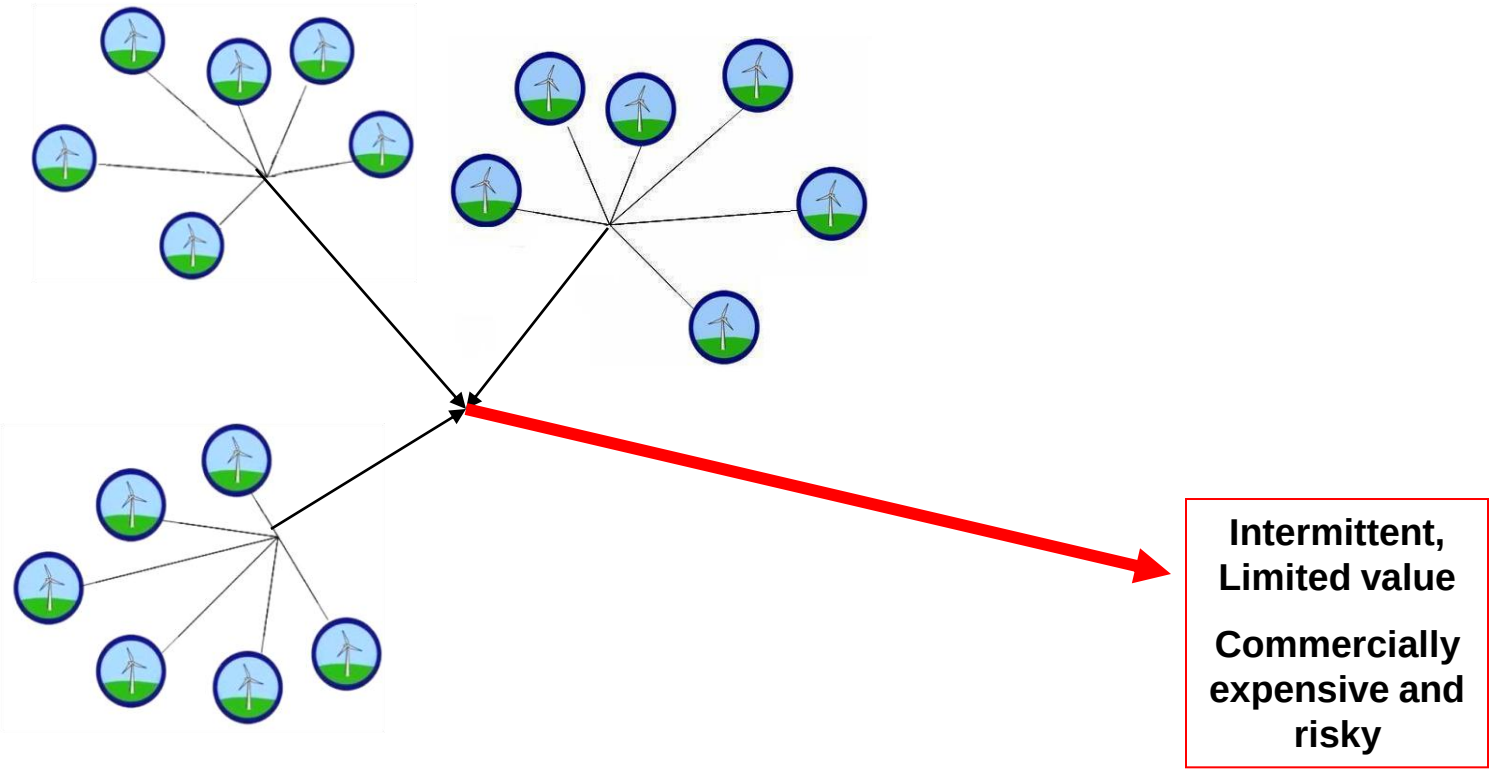
5,000 offers, 28 Teams – over 100+ prof.

Natural Hydro Energy

1. Project Leadership
2. Hydro Design
3. Civil Engineering
4. Environmental Habitats
5. Environmental Planning
6. Architecture
7. Landscaping
8. Wind farm Development
9. Collection Network
10. Transmission Network
11. Western Communities
12. Manufacturing Ireland
13. Education
14. Training
15. Geology
16. Advisory Board
17. Board of Administration
18. Programme Management
19. Government Communications
20. Legislative
21. Finance Dublin
22. Finance London 1
23. Finance London 2
24. Legal Corporate
25. Legal Commercial
26. Tax
27. PR, Media
28. Web Communications

Wind – Low fuel cost but Limited value

- Wind on its own is intermittent, unreliable and does not replace nuclear, coal, gas or oil.



Pumped Hydro - Energy Arbitrage

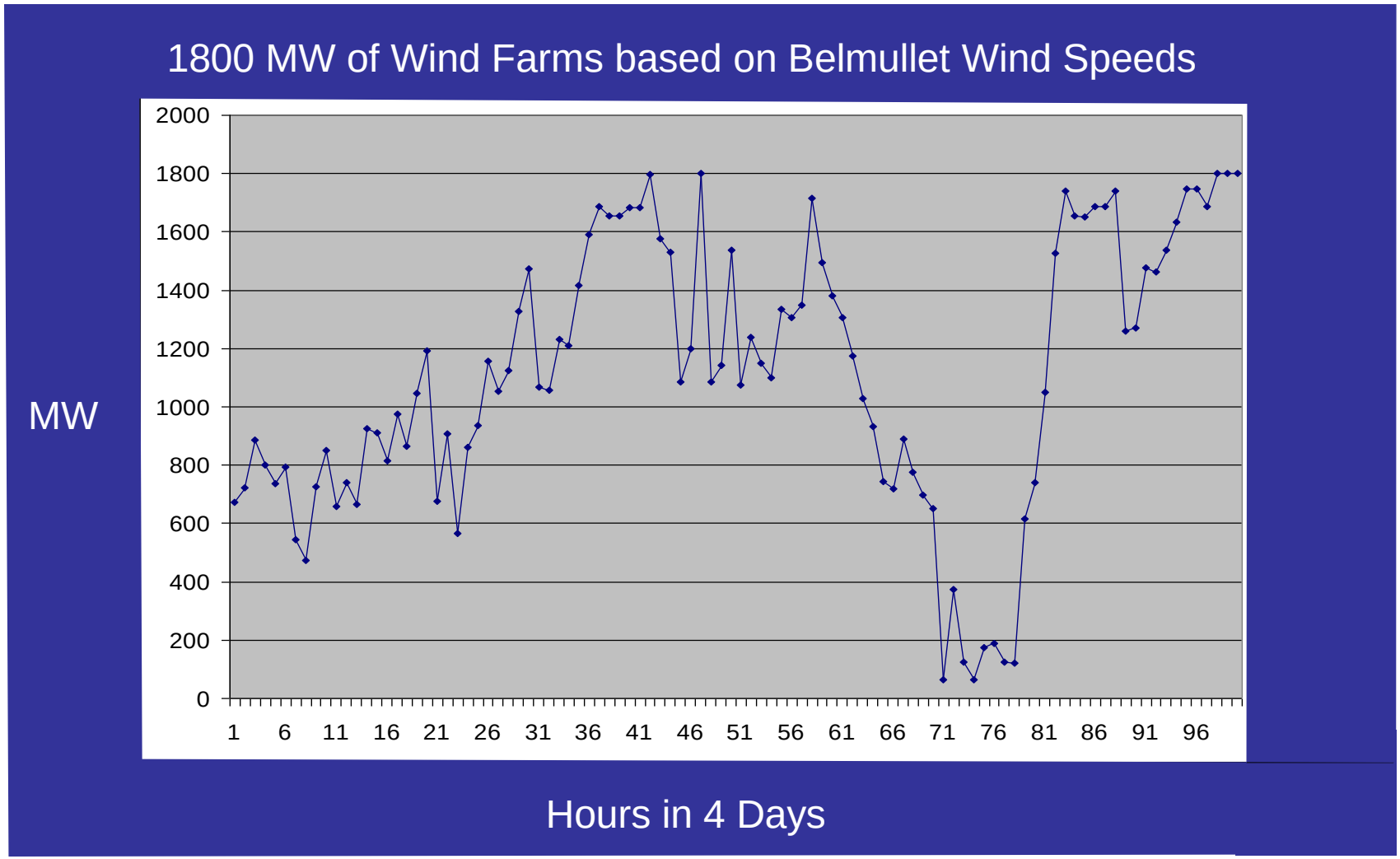
- Valid business model but dependant on buy cheap sources
- Highly profitable if low enough capital costs
- Modest capital security

No energy Creation

Capital intensive

Dependant on buy prices

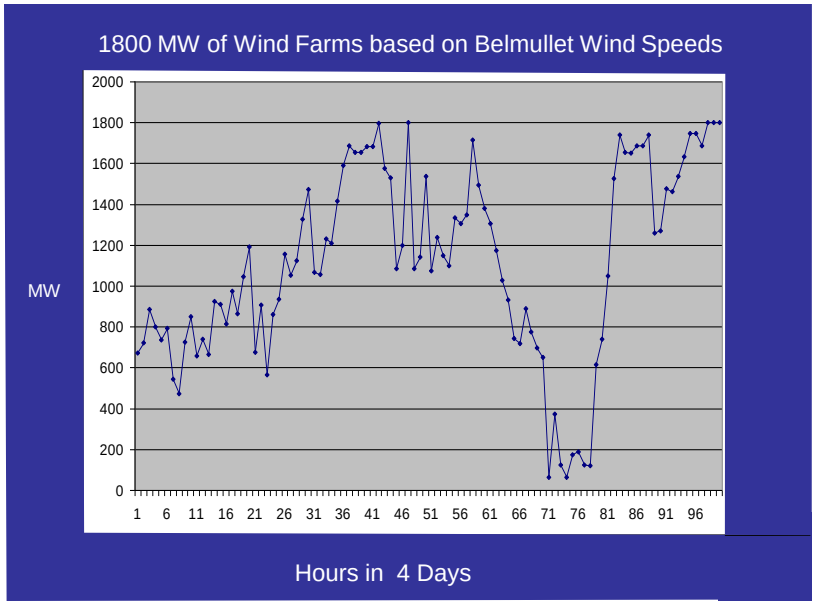
The Technical Problem

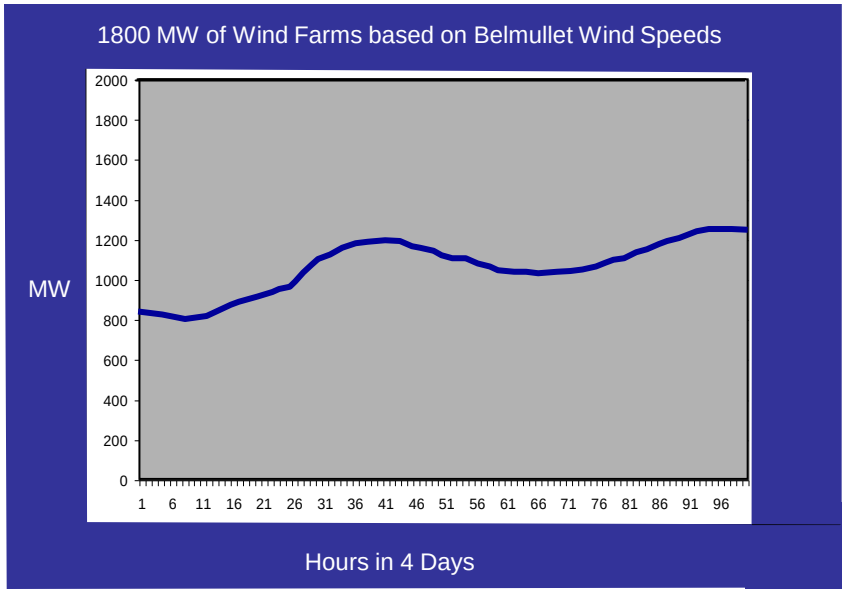


Achieved Solution Results

- Volatile, Variable wind
- Technically Challenging
- Not Dispatchable
- Expensive
- Unreliable

- Even
- Dispatchable
- Commercially Valuable
- Investable
- Reliable, Secure

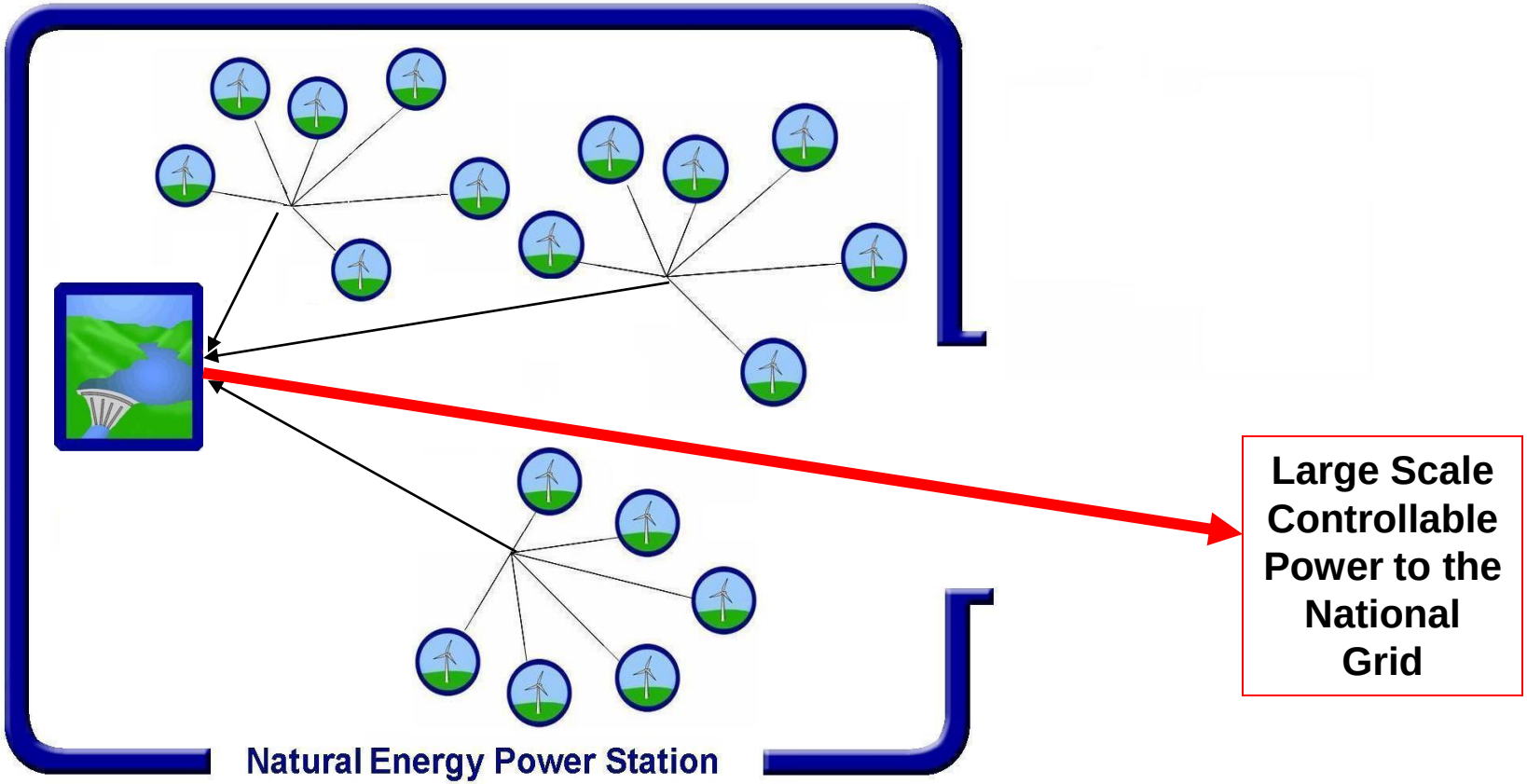




Natural Hydro Energy Business

Low Cost High Output wind **+** Low Cost, High Output Storage

= Highly profitable Carbon Free, Price Stable, Secure business



Storage vs. Interconnection

- Both are necessary
- Each has its own economic dynamics
- The combination of the two makes a commercial product
- The correct balance is that which provides the optimum return and in which Investors want to invest

Natural Hydro Energy

Professor Igor Shvets

Hydro Storage

Objectives – Energy Storage

- To build a large scale hydro storage plant powered by dedicated renewable energy sources, primarily on-shore wind farms.
- Facilitate connection of new renewable energy sources in the future once they come on-stream such as wave power, tidal power, etc.
- The plant capacity should be large enough to overcome wind intermittency, 50 GWh or more (preferably 90 GWh).
- The hydro storage plant in combination with wind farms and collection network then operates as a coherent Natural Energy Power station.
- Produces dispatchable power on demand.
- Zero carbon dioxide emissions.
- Layout, costs and operation of this plant should such that the enterprise becomes commercially viable.

Hydro Energy Storage

Natural Hydro Energy

Purpose of the Task

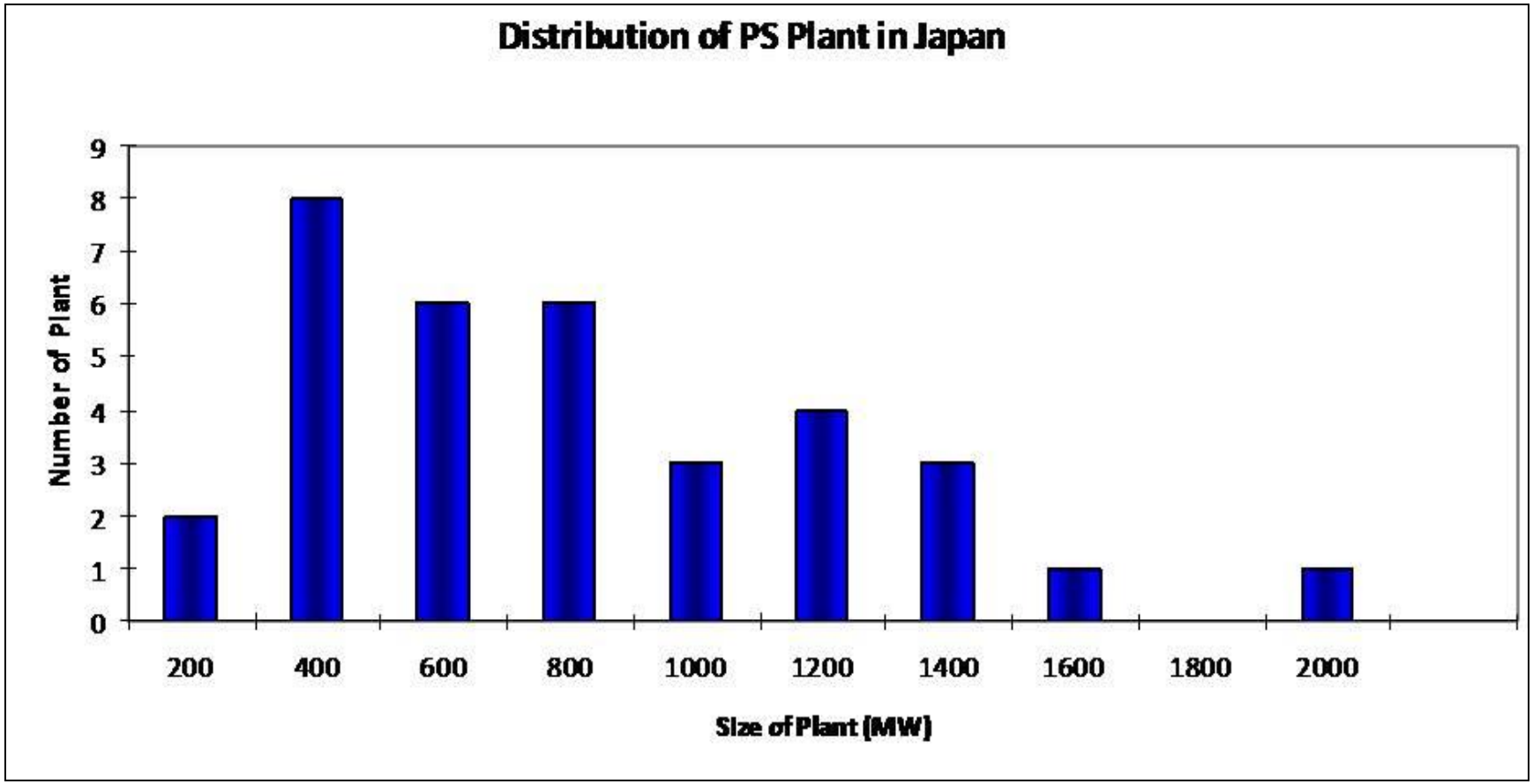
- Determine the best plant layout and construction method for the project, taking into consideration:
- Plant Functionality
- Environmental Impact
- Local support for the Project
- Safety
- Efficiency
- Cost
- Long-term Viability
- Visual Impact
- Suitable Transmission Line Routes
- Limitations of the local infrastructure (road networks etc.)

Produce cost estimates for each component; these should be provided or confirmed by experts and/or companies working in the relevant field.

Hydro Energy Storage Europe

Pumped Storage Japan

- Japan has 34 Pumped Storage plants with a combined power output of 24.5 GW. Average size is 720 MW. A further 3 GW of pumped storage is proposed.

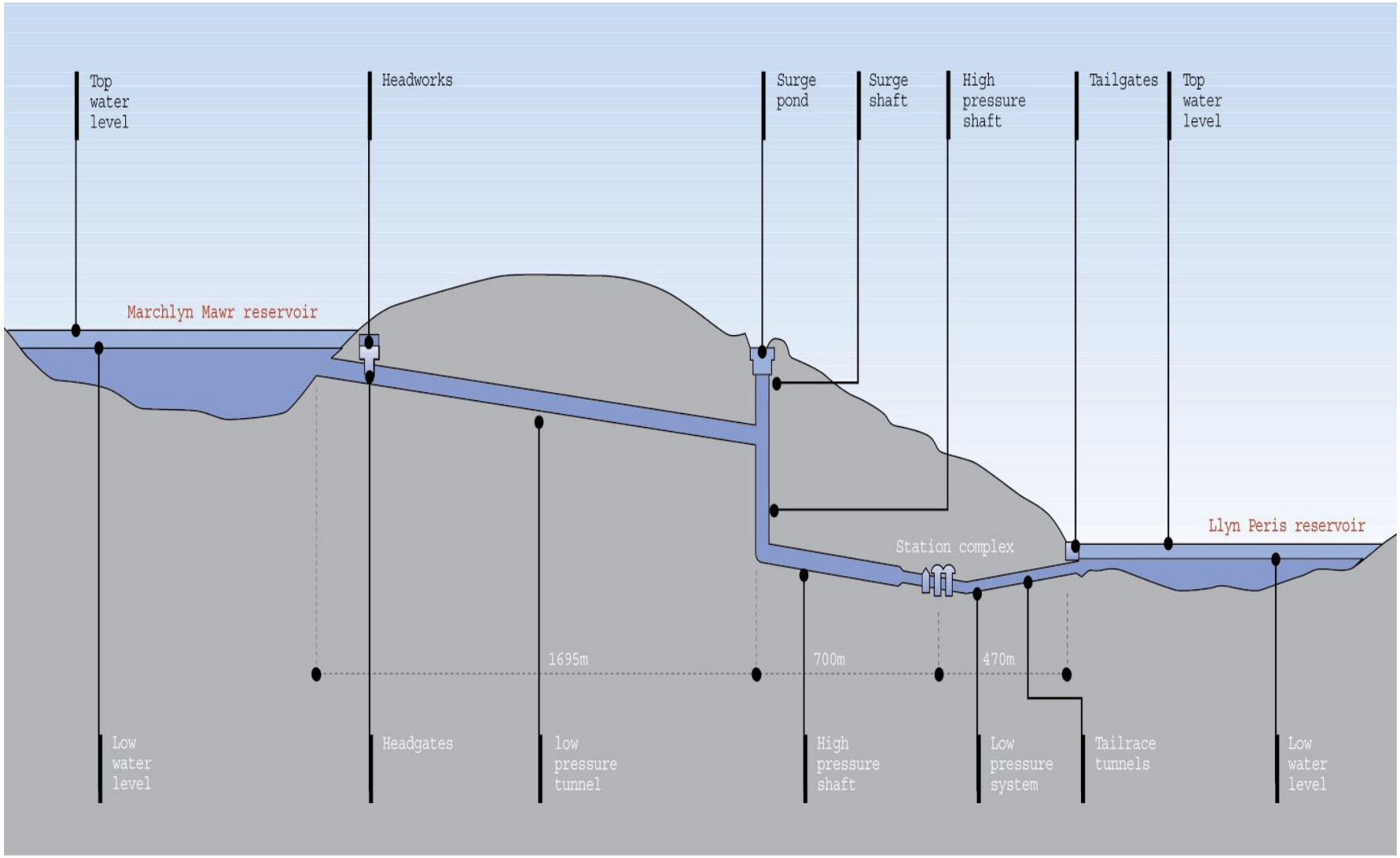


Hydro Energy Storage EU

- There are over 90 pumped storage plants in the E.U. with a combined output of 28.1 GW. Average plant output is 460 MW.
- A further 5.1 GW is proposed.

Coo-Trois-Ponts Pumped Storage Station, Belgium

Classic Hydro Pump Storage Arrangements



Dinorwig – "Electric Mountain" - Wales

- Snowdonia National Park
- Large Peaking Hydro Power Station
- Commissioned in 1984
- Capacity 1800 MW
- Cost then £425m.

Dinorwig Upper Reservoir 7,000,000 cms

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Dinorwig Wales Reservoir

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Underground Tunnel Configuration

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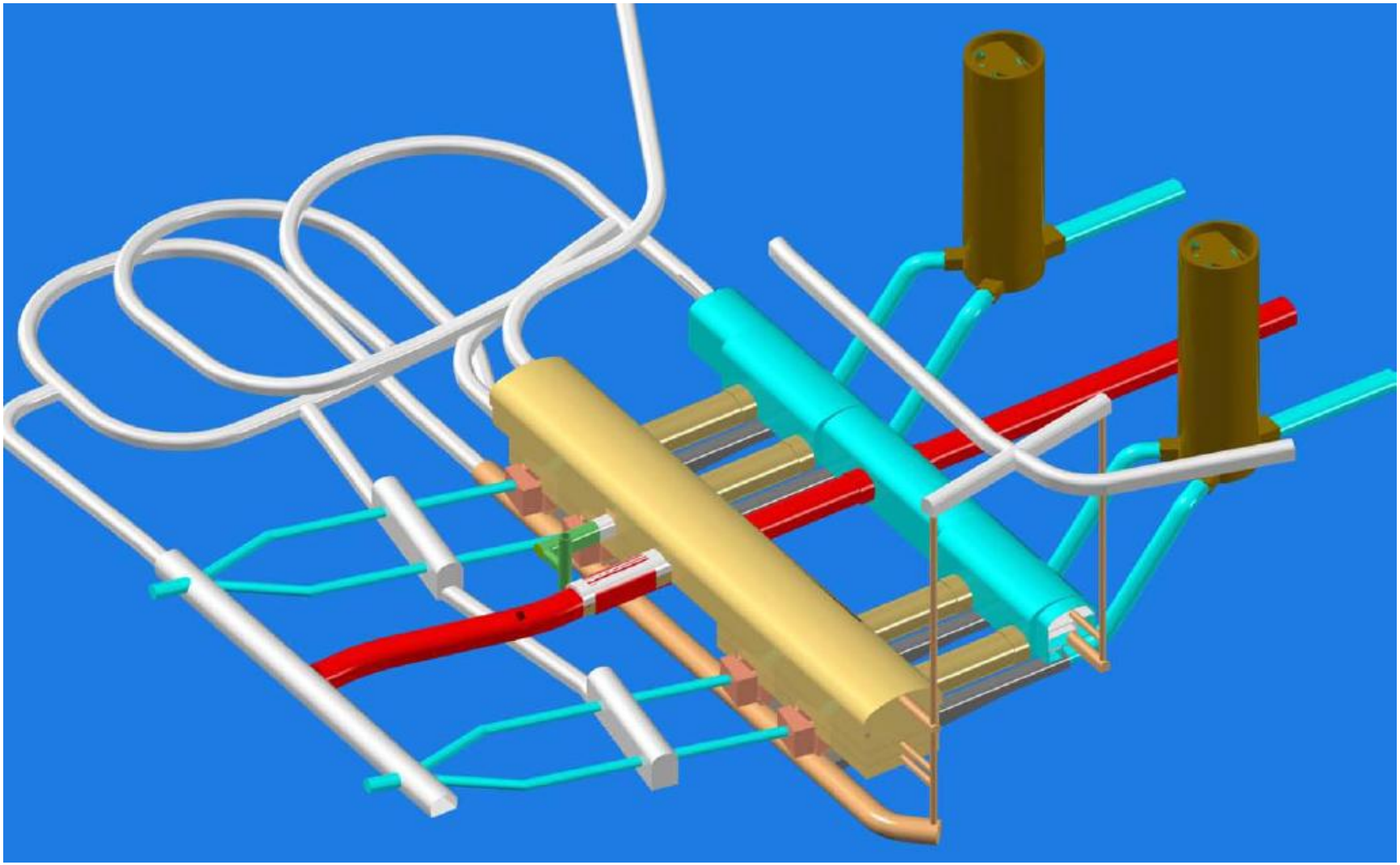

Tunnelling – 16kms

Lined Penstocks

Generator Hall

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Turbine – Generator Shaft

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Generator

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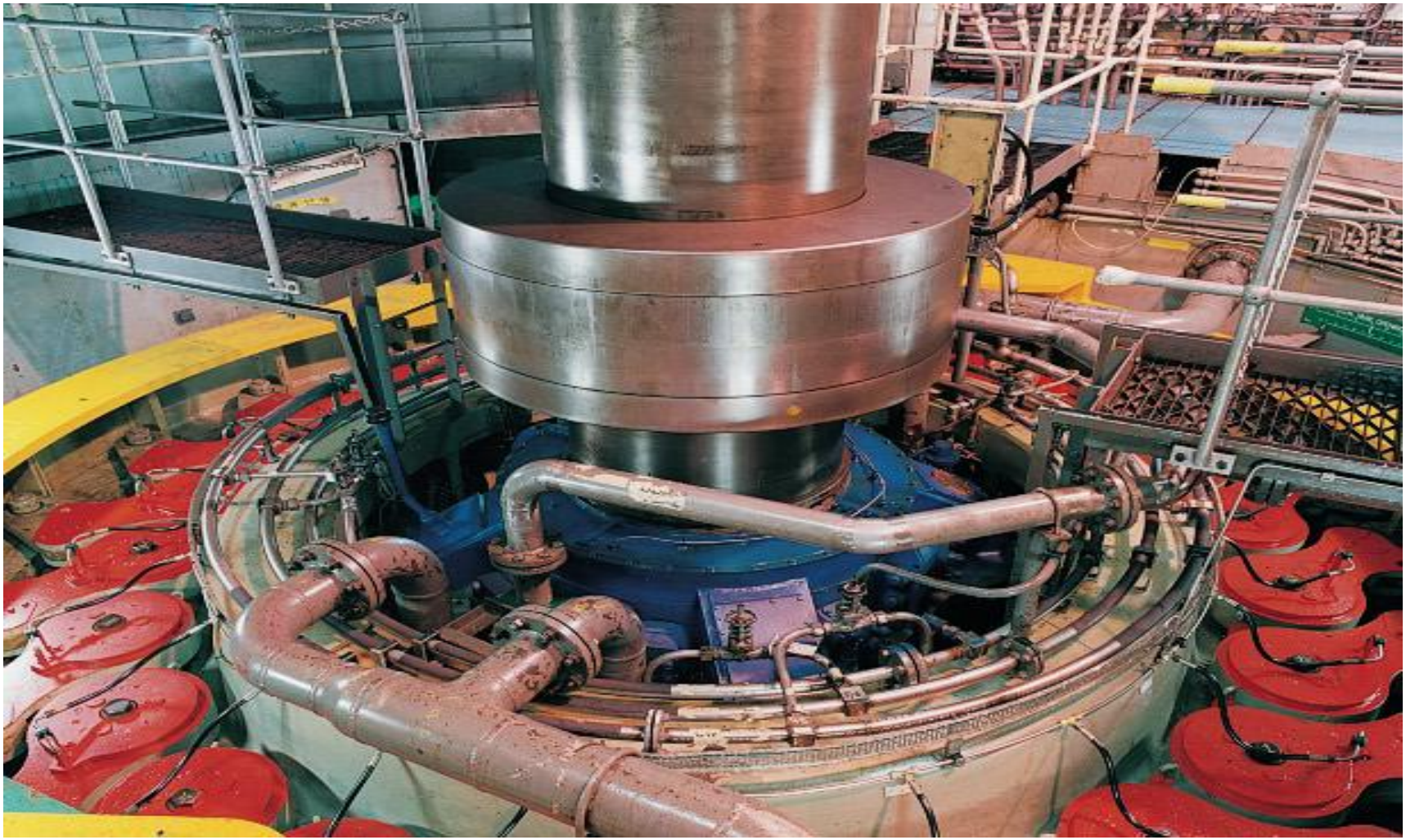

Control Valve

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Control Valves

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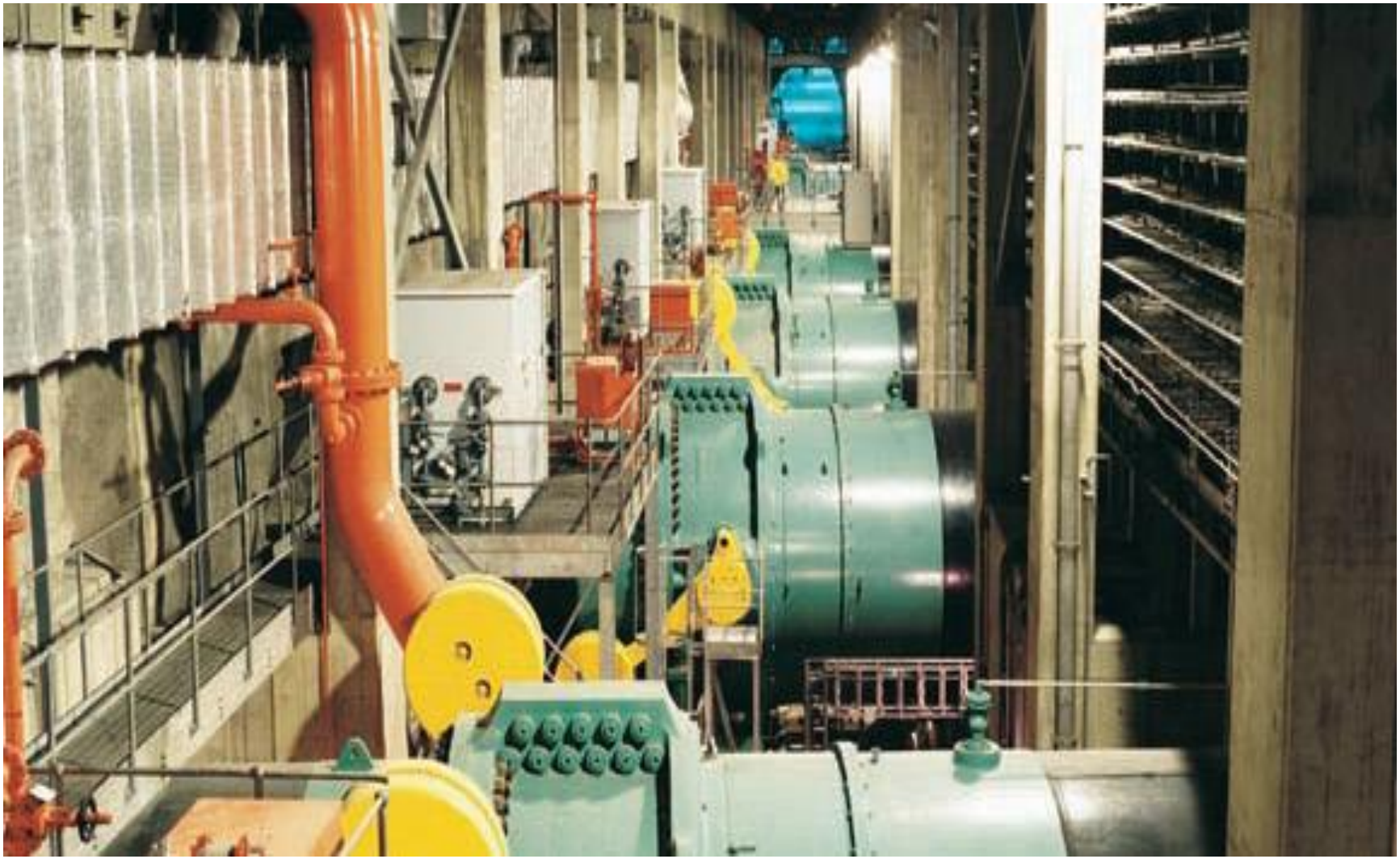


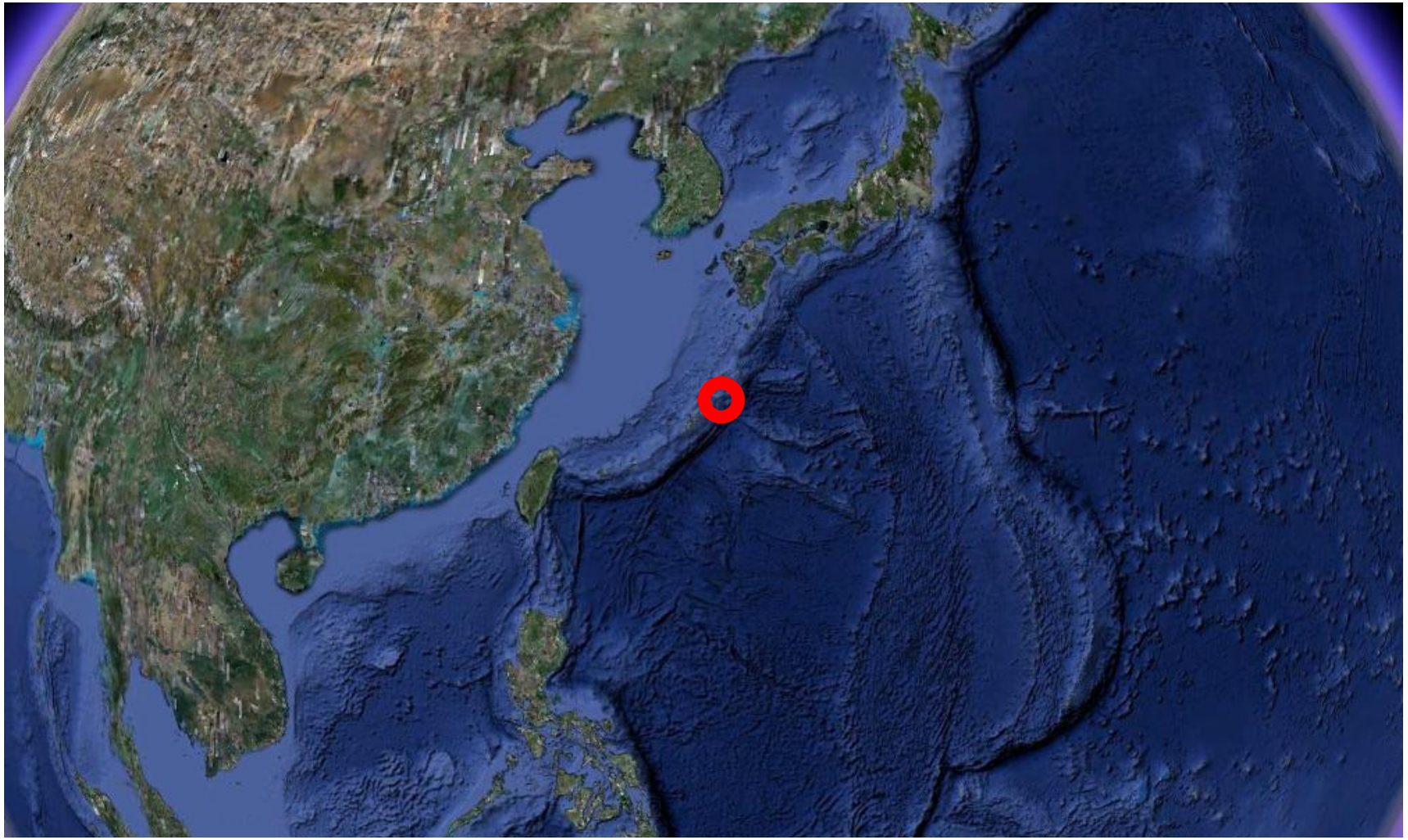
Underground access by bus

Okinawa – sea water facility since 1999

Okinawa seawater pumped storage built by J-Power. This uses seawater, it doesn't make use of a naturally occurring reservoir. It has been operational without any major problems since 1999.

Japan – difficulty geology

- Okinawa Island – edge of Pacific Ring of Fire



Coastal Power Plant US

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Tidal Power Station Canada

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Seawater Cooling Nuclear power Germany

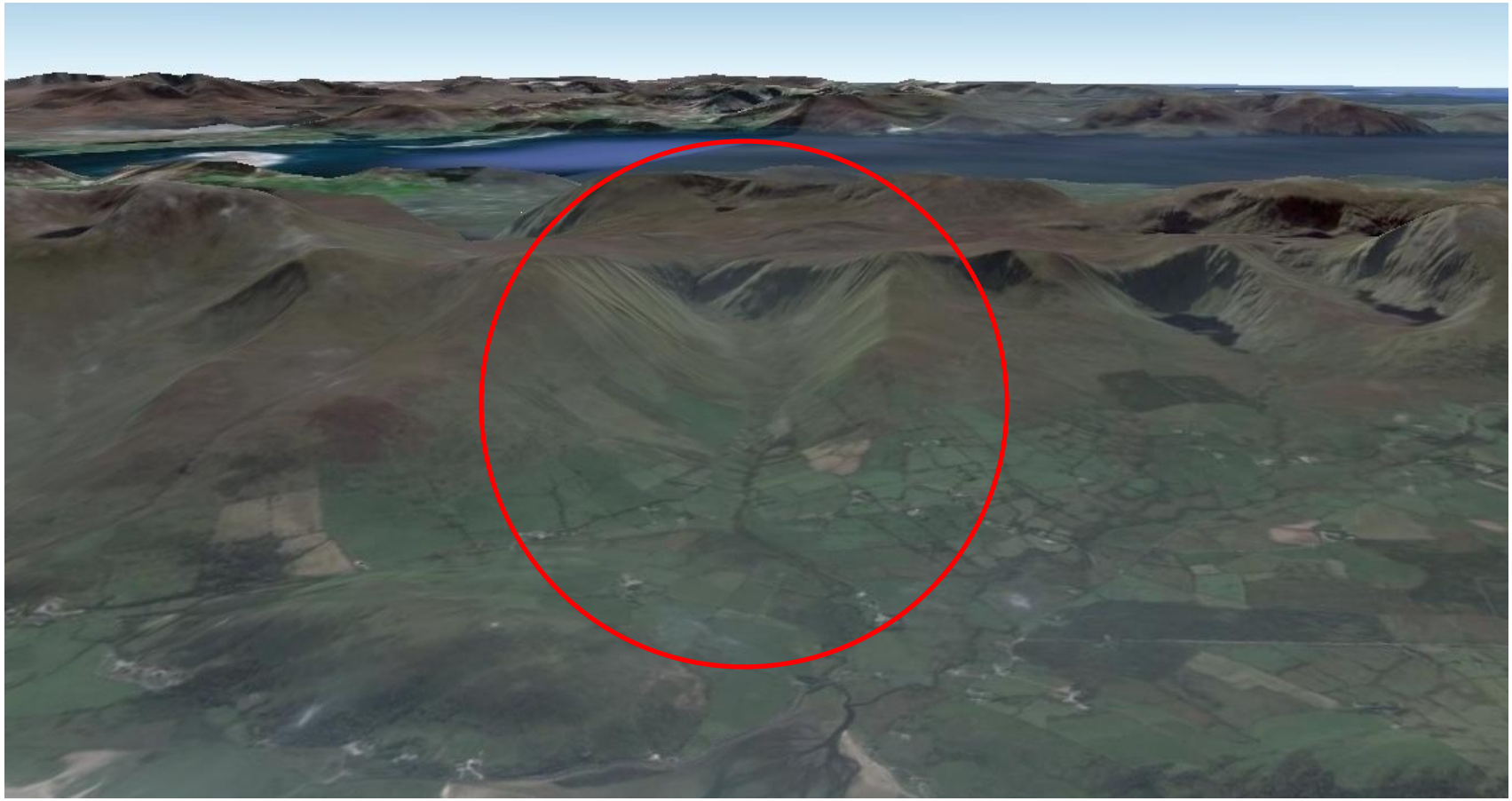
Energy Storage Locations

- The west coast of Ireland has many areas proximal to the ocean that can become large energy stores

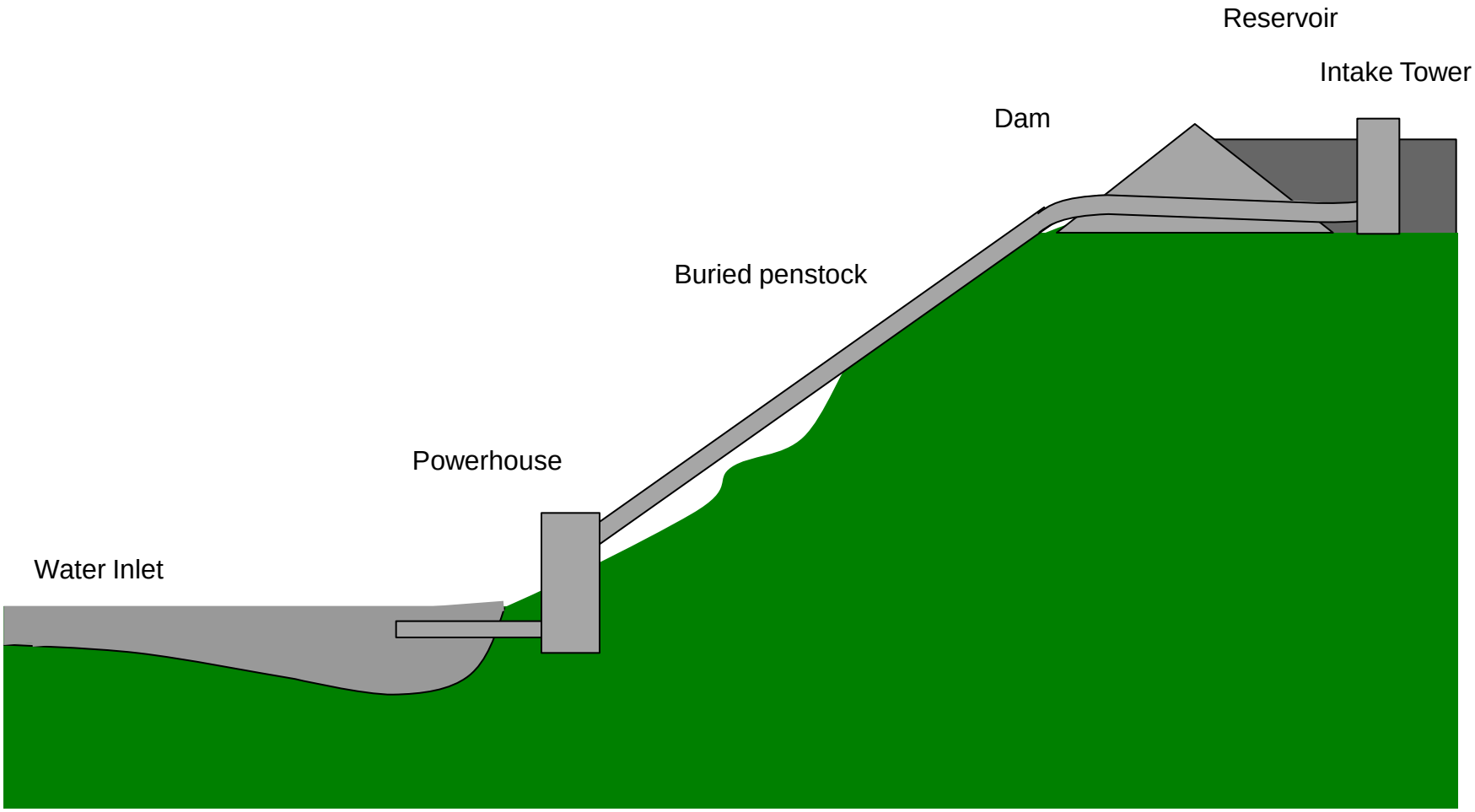
- Limited tidal movements along the west coast of Ireland are an enormous advantage

Example of Hydro Energy Storage Valley

- Example of a potential site for a Hydro Energy Storage Reservoir 2/3 km from the ocean, the lower lake



Above Ground Configuration



Comparison of build types

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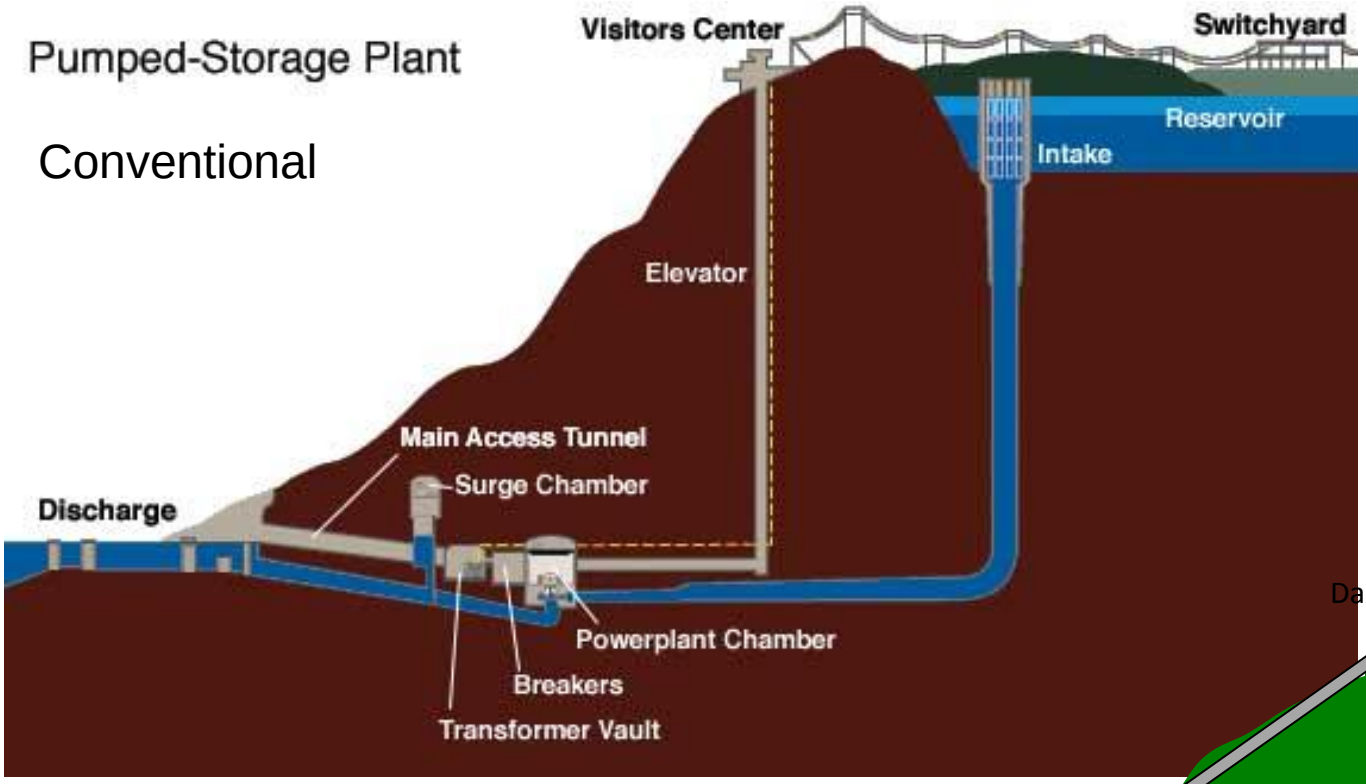

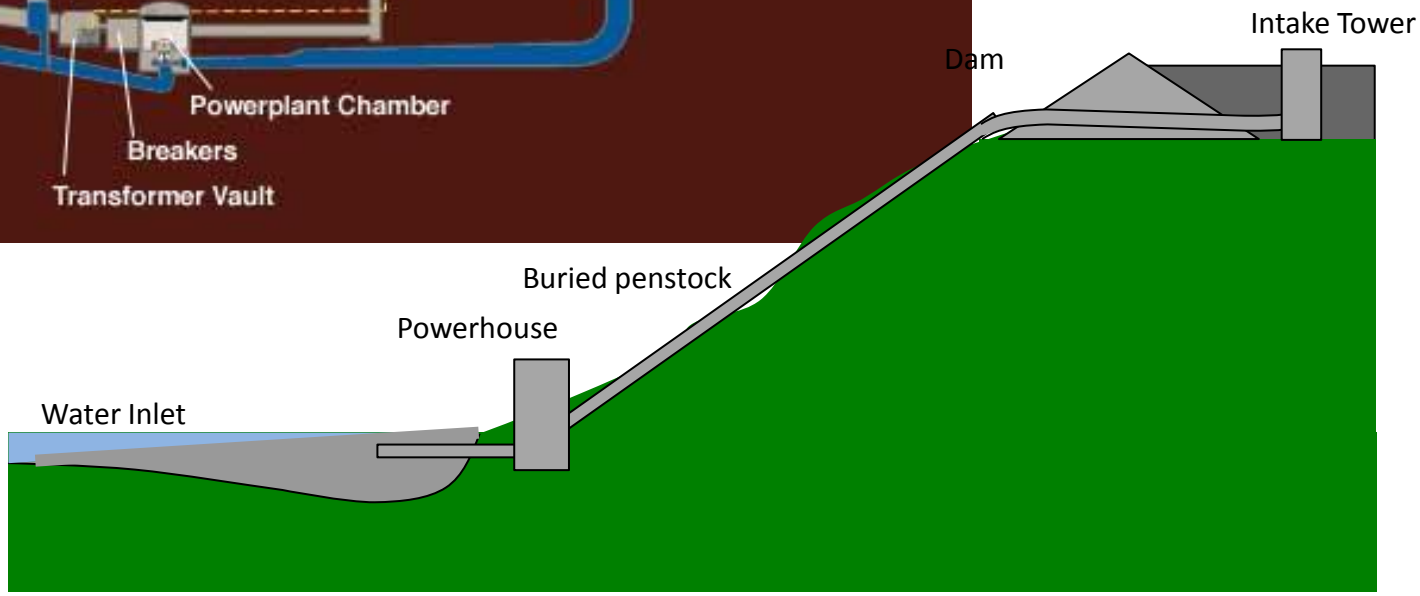

NHE Cost / MW
40-50%
Storage MWh
10x – 20x

Geophysical Investigations

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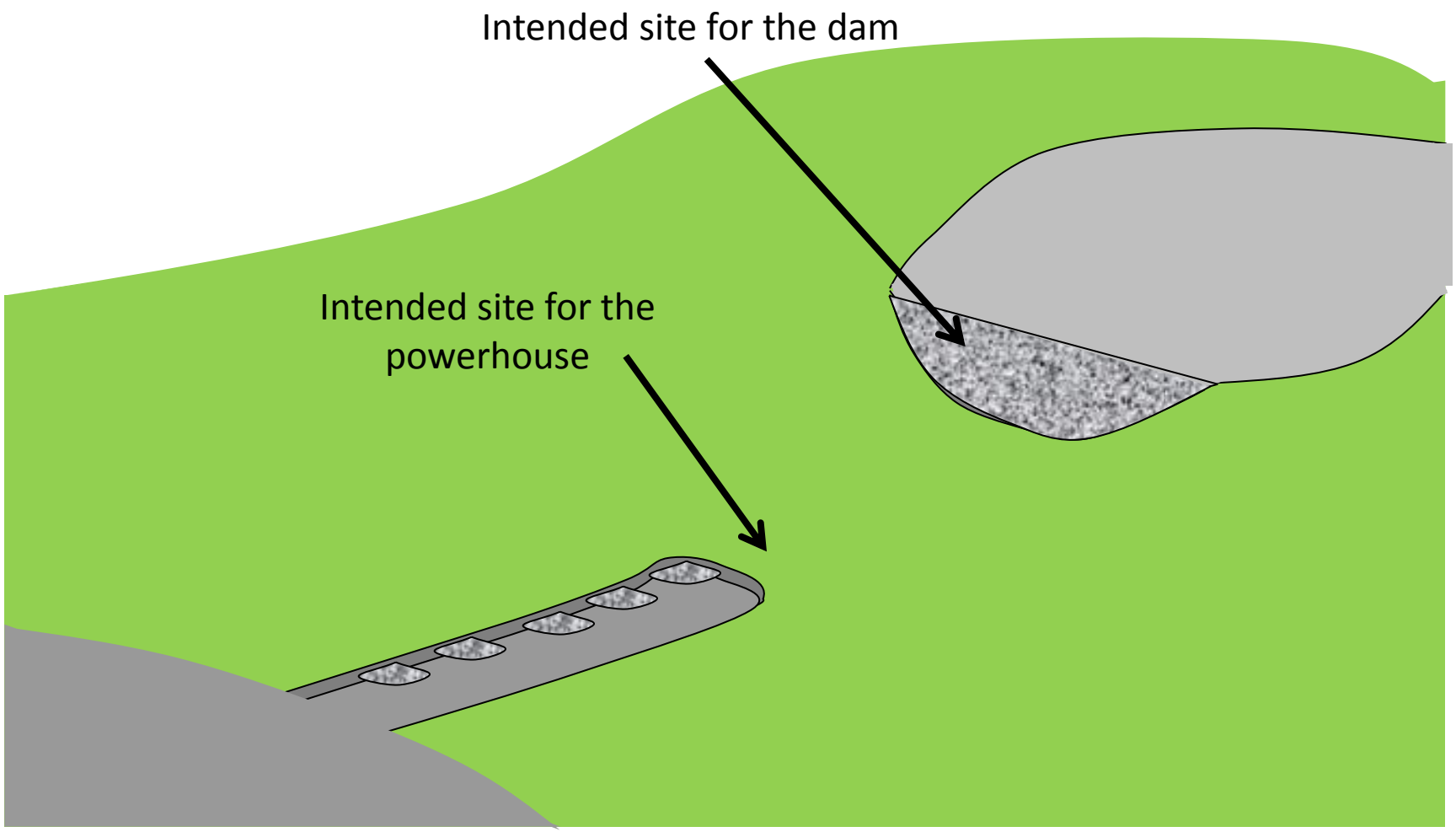
Methodology

- LiDAR Survey (1.0 m contour generation) of entire project area, i.e. Reservoir basin, Dam, Penstock, Powerhouse and Ocean Intake.
- Barometric Survey of Ocean Intake and Breakwater areas.
- Geological mapping, including bedrock, faults, etc.
- Seismic Assessment.
- Drilling, Test pits and Seismic Refraction Survey.
- Lab Testing and Reporting.
- Map of the peat deposits within the reservoir area, estimate the amount of peat to be moved from the site of the hydro storage reservoir.

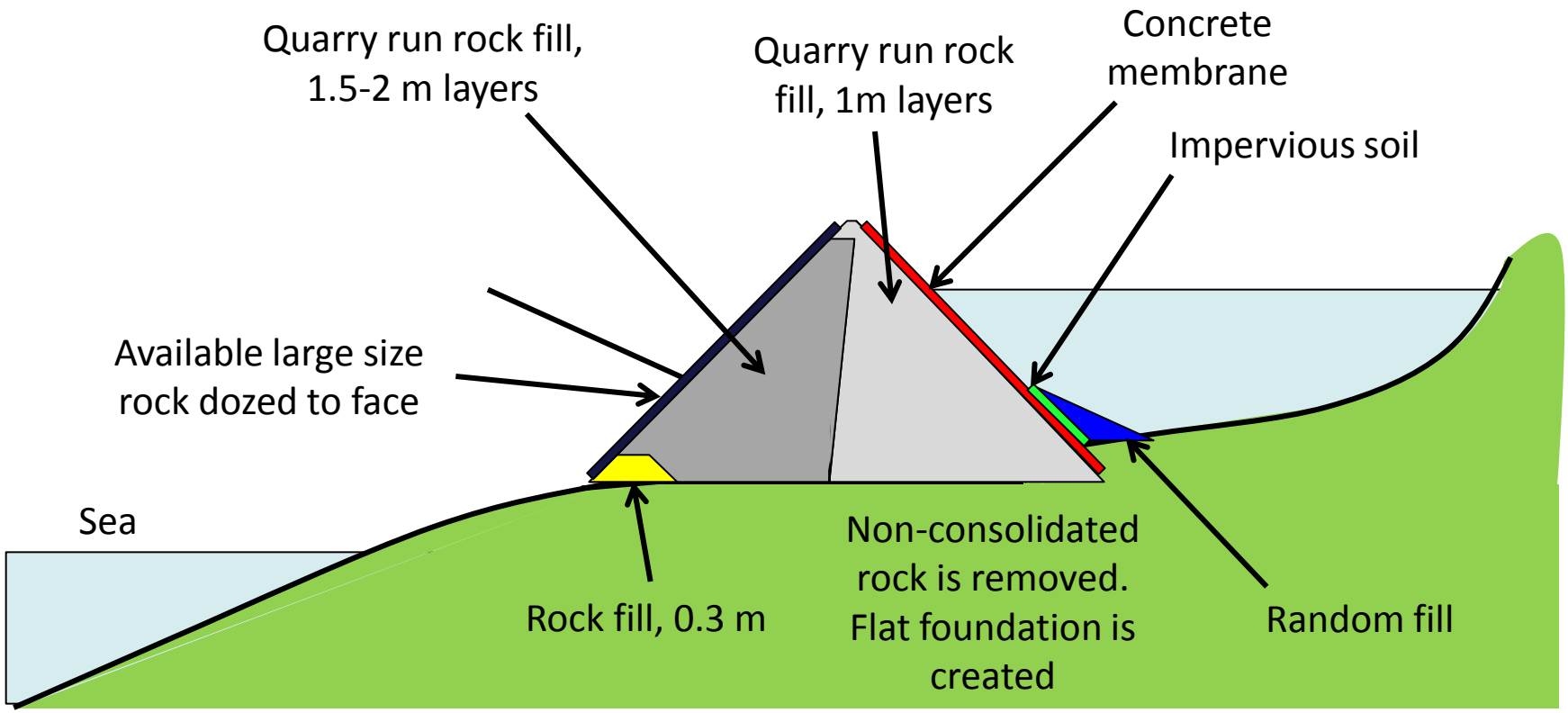
Foundations and Civil Works



Foundations and Civil Works

Natural Hydro Energy

Methodology



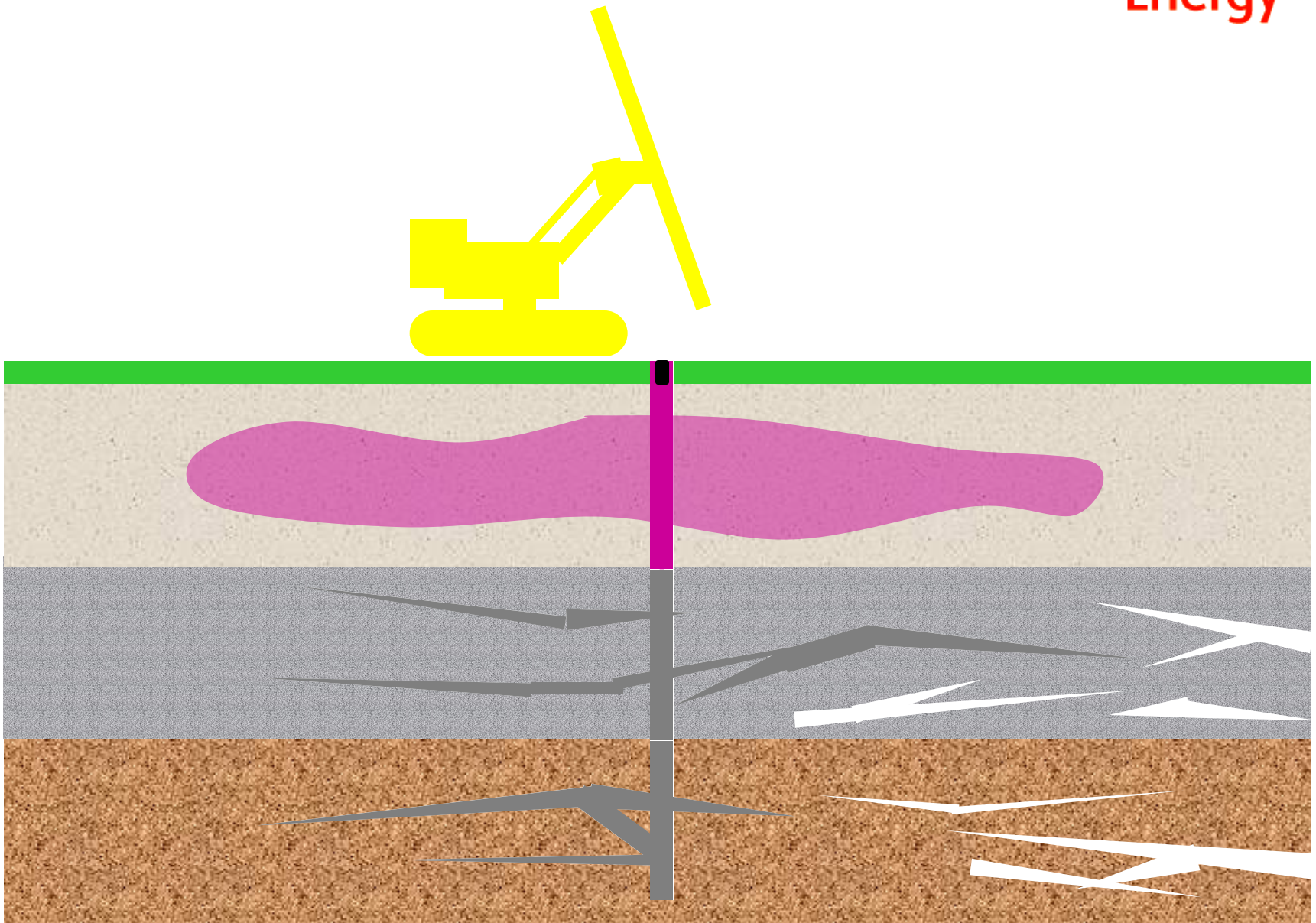
Water barrier inside dam surface

Completed Rockfill Dam

View of completed rockfill dam in Australia

Completed rock filled dam

Grouting



Installing low-density lining at Lisheen

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Penstock Transport

Penstock Rolling from sheet steel

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Penstock Construction – before and after

Penstock Construction – before and after

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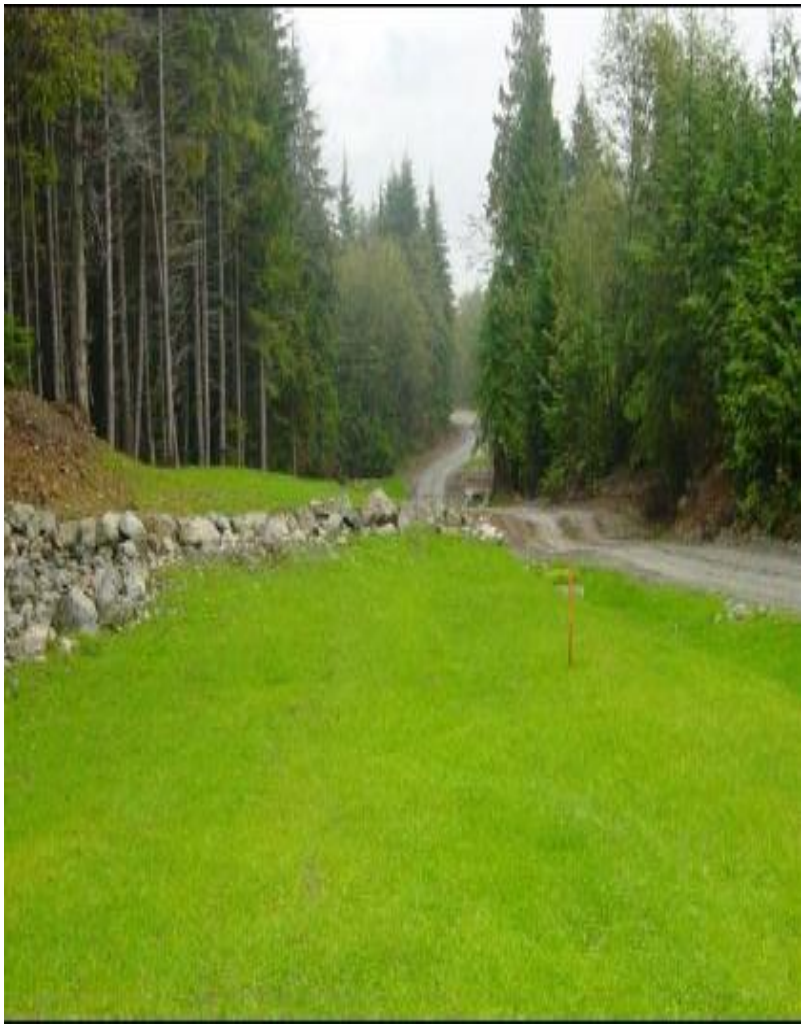

Generator Hall Design

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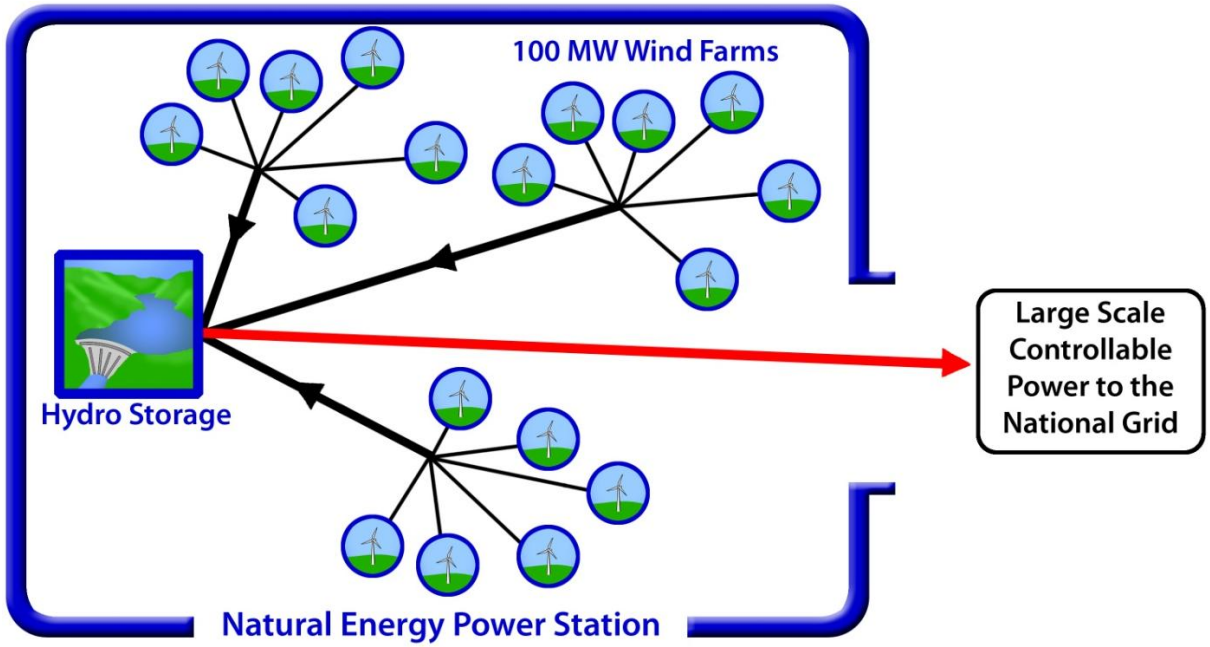
Dr Pat O'Donoghue

Wind Farms
Power Networks
Collection Network
Transmission

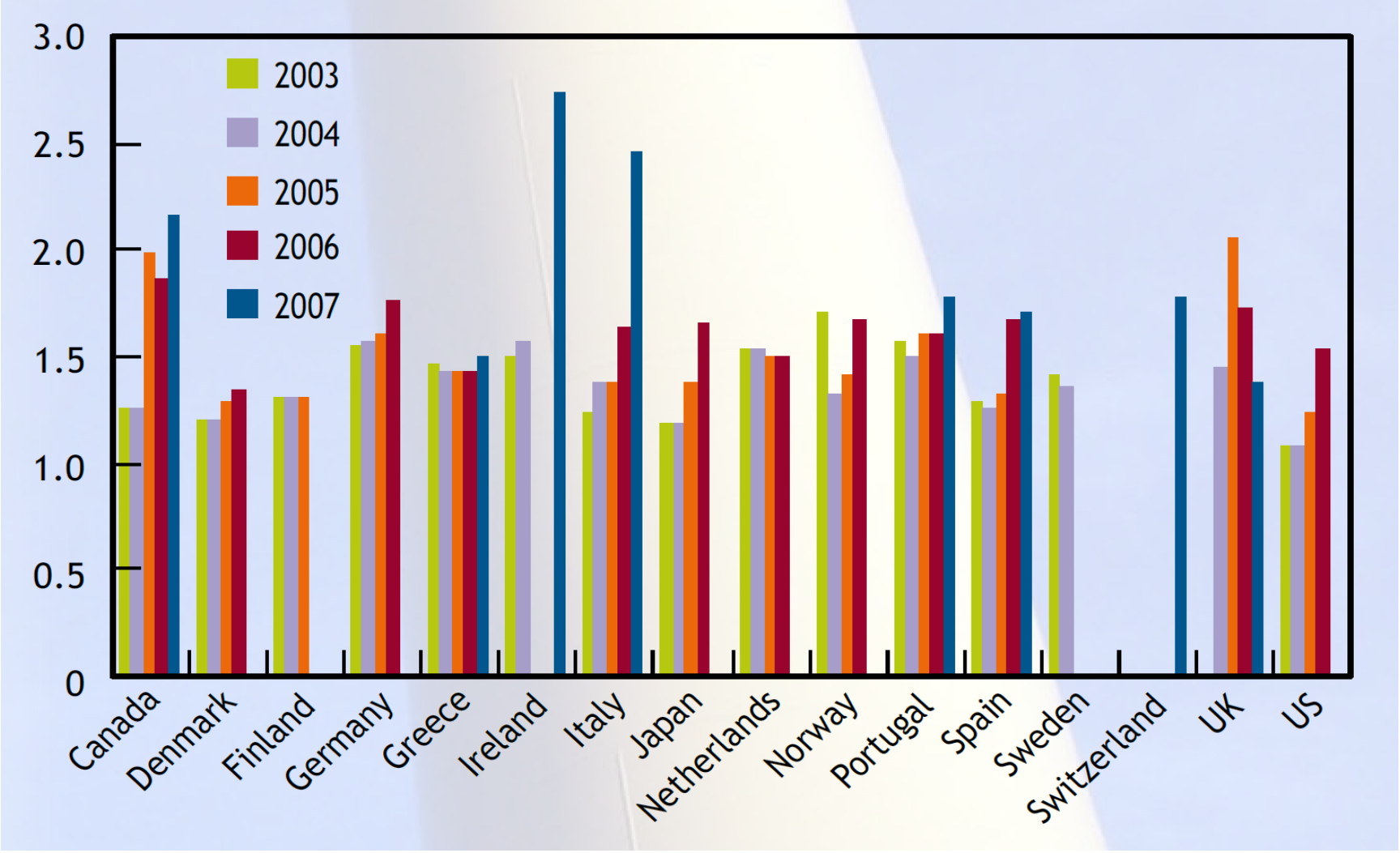
Natural Energy Power Stations



- Wind + Storage
- Tightly Coupled
- Symbiotic Operation
- New Dedicated 220kV Network
- New underground West – East Line
- Bulk Purchase Wind Turbines
- Dry Build Low Cost Hydro Station
- Conventional Technology

Output = Carbon Free, Price Stable, Secure Power

IEA – Onshore Wind Costs per MW installed



IEA Issue related to Wind development

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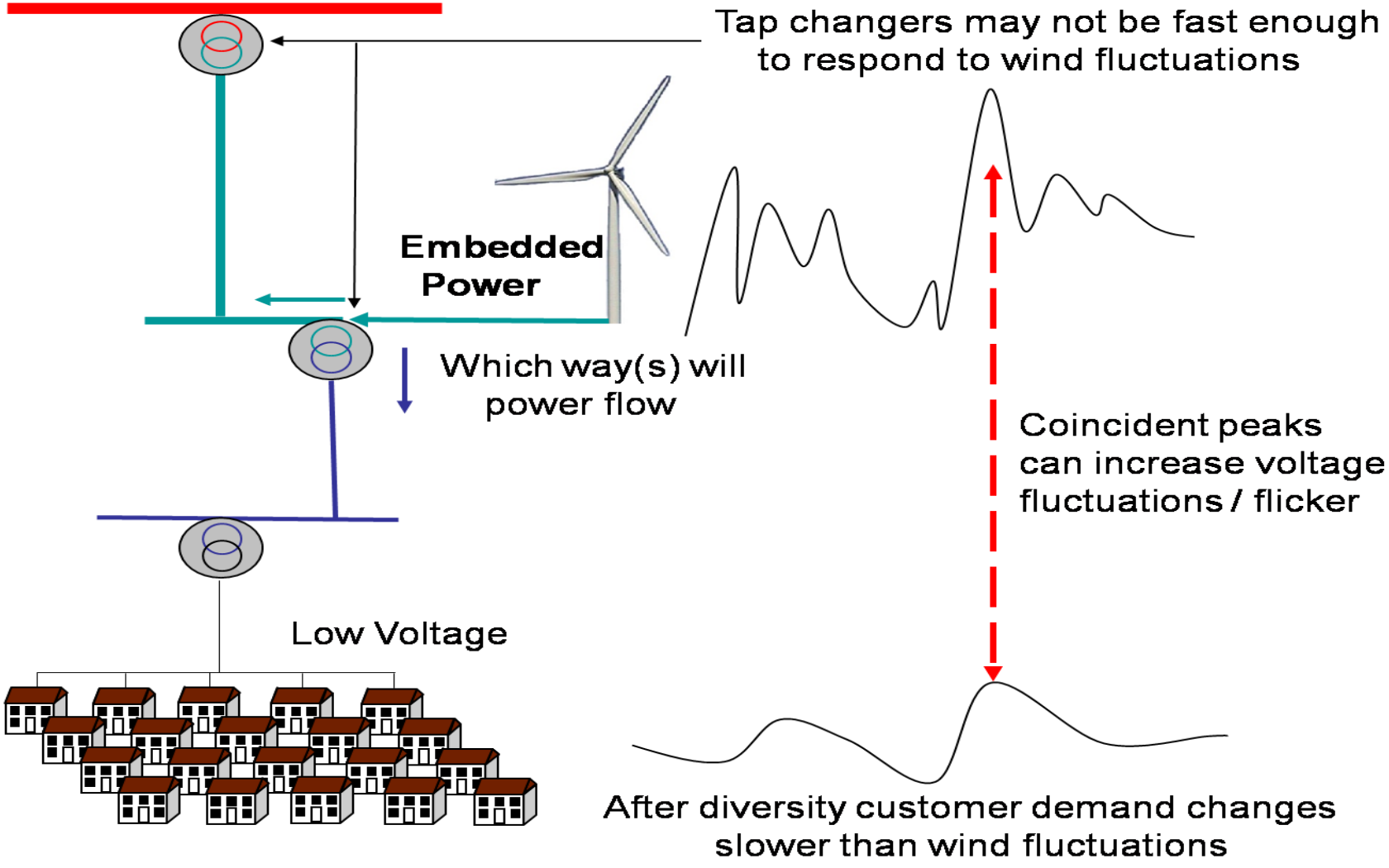
- Barriers to wind energy development include
- Uncertainty relating to the future of incentive schemes
- Concerns about the impacts of variability on power system reliability,
- Access to transmission,
- Perceived visual and ecological impacts,
- The structure of conventional electricity markets.

  (The latter evolved around conventional generation and utilities, and in many cases could be optimised to facilitate wind power participation.

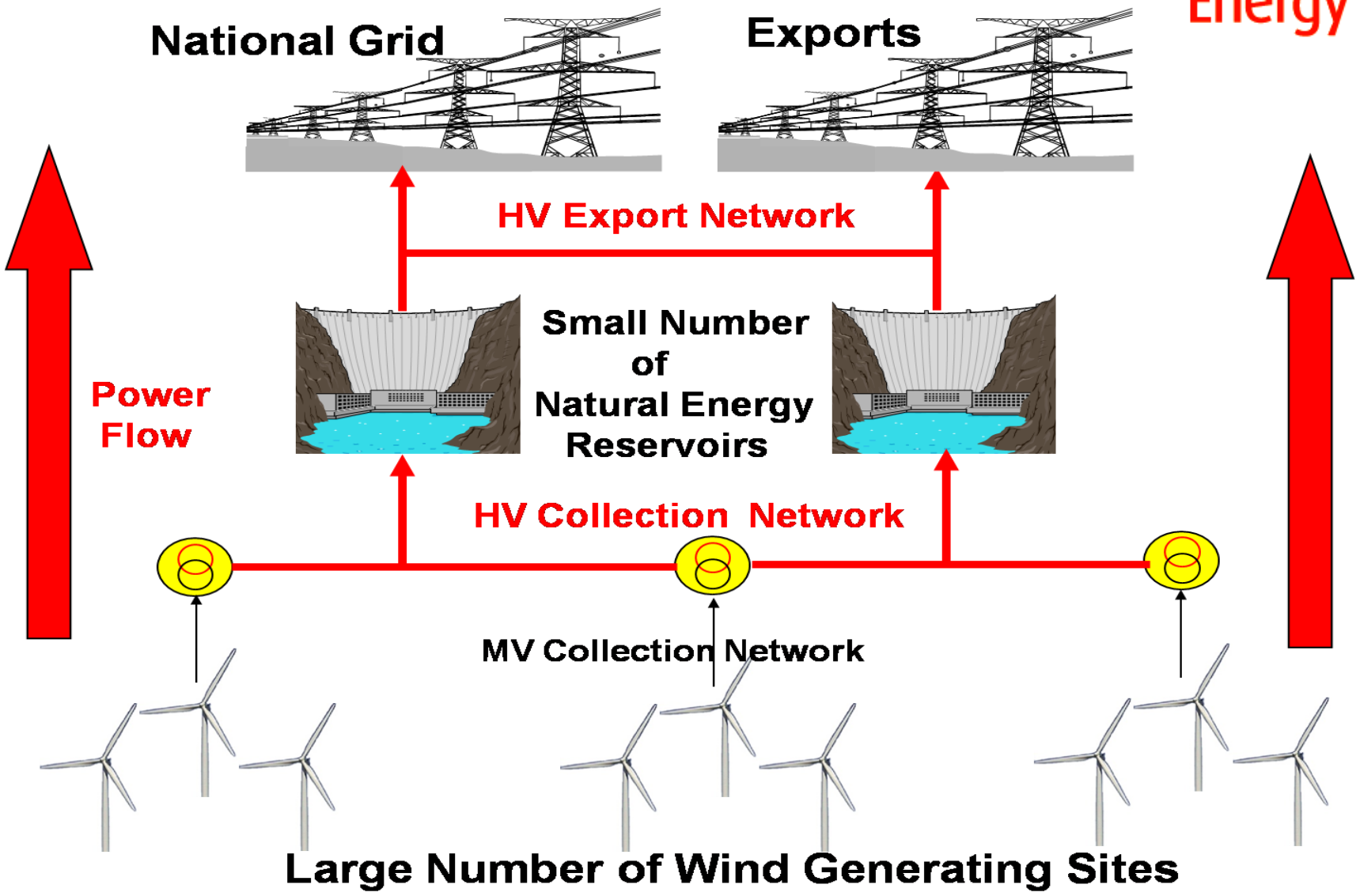
Wind Farms

- Analysis of 2 years wind speed data from Malin Head, Belmullet, Shannon Airport, Valentia, Eirgrid data
- Planning basis 33% Capacity Factor
- Hellman Exponent 0.15 – 0.2 Germany 0.16
- Planning Basis 0.15
- Planned Cost €1.3 million / MW installed
- Economies of scale @ 100 MW wind farms
- Commercial leverage on 1800 MW bulk purchase

Network Disturbances with wind



Powerflow


National Grid
Exports
HV Export Network
Power Flow
Small Number of Natural Energy Reservoirs
HV Collection Network
MV Collection Network
Large Number of Wind Generating Sites

Portal Frame 230kV lines Canada

Collection Network

Natural Hydro Energy

Portal Frames in Irish Landscape

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Cable Laying

- Right of way 4m
- 400 field joints – no failures

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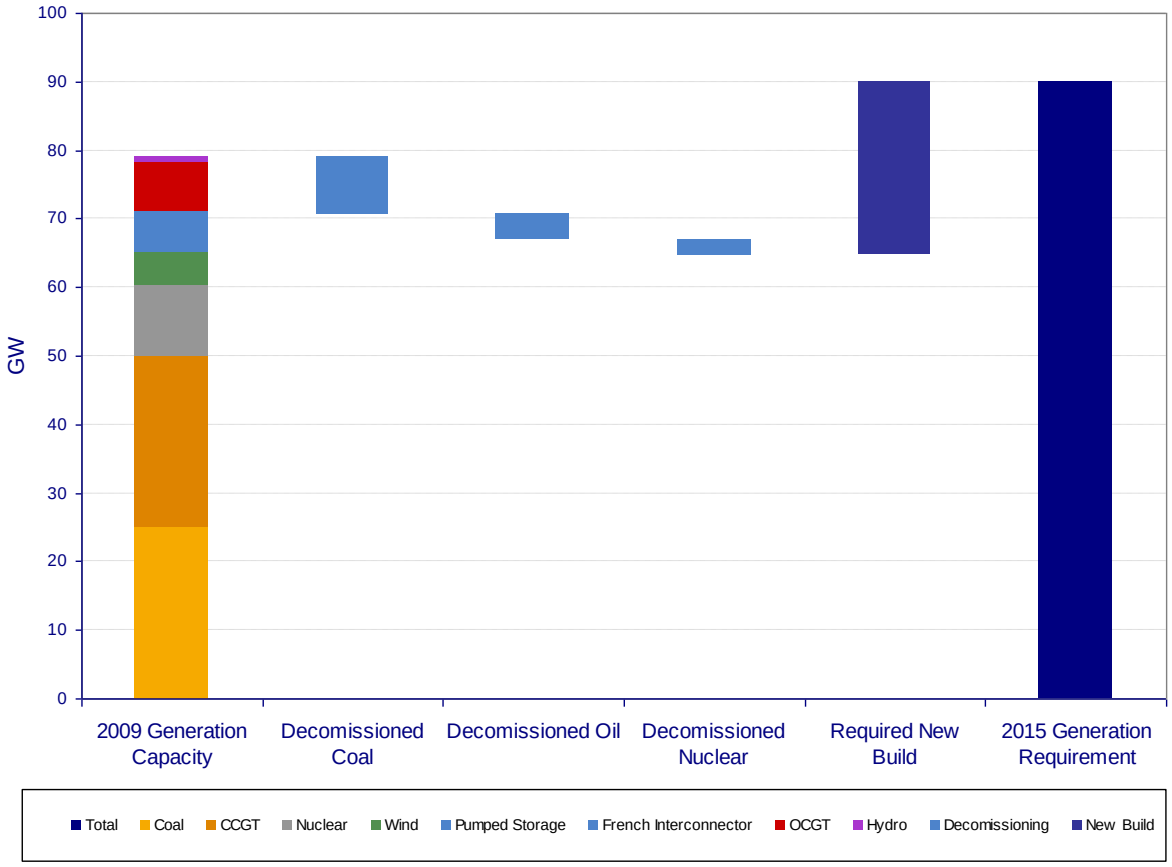
Graham O'Donnell

Commercial
Social
Political

UK Power Requirements

UK Electricity Generation Capacity – 2010E vs. 2015E



Source: National Grid Winter Outlook Report 2009/10, industry reports, company filings and company websites

Commentary

- UK facing power shortages in 2015
- 12.1GW of coal and oil generation capacity opted out of the EU's Large Combustion Plant Directive (LCPD)
  - Mandatory decommissioning by 2015 but maybe by 2013
- Limited risk of UK electricity shortages prior to LCPD plants being decommissioned
  - Accelerated risk if LCPD plants forced to decommission by 2013
- NHE proposal represents a small amount of UK's 2015 need.
- Completion of Dublin/Wales 500MW interconnector in 2012
- Life of nuclear facilities may be extended to 2019 but likely cost at least £100m
- Additional 6.0GW of UK's 10.4GW nuclear generation capacity decommissioned 2015-2023

UK Generation Shortage In 2015 Due to Mandatory Decommissioning of Current Capacity

Natural Energy Industry Framework

Technical	Commercial	Financial	Legal/Social	National
Large Scale Energy Production	Lower Cost of Power than Coal or Gas	High IRR	Community Commercial Participation	Major Economic Stimulus
Carbon Free	Huge shortage looming in the UK	Long Term Returns	"Co-op" model	Large Scale inward investment
Price Stable	UK Power Buyers seeking long contracts	Appetite for Investment	Local Employment	Carbon Free Power Secures FDI
Low Capital Cost	Highly Profitable	Multiple Sources	Construction	No Extra Cost to Government
New Power Infrastructure		UK Power Operators	Engineering	Tax income
Fast Construction			Cash flow to local government and communities	Employment
Fast progress to 2020 Targets			Smart Economy Boost	

Planning Process

- Consultation with DG Environment Brussels has started
  - Very positive "ticks all the boxes"
- Full Environmental and Planning Process – "no shortcuts"
- Environmental Full Assessments
  - Strategic Environmental Assessment (SEA)
  - Appropriate Assessment process (AA)
  - Water Framework Directive
  - Habitats Directive Assessment

  Must pass all stages both locally, nationally and Brussels
- Planning
  - SIA

Community Involvement Essential

- Community Commercial Partnership structured (CCP)
- Consultation with Counties
- County wind strategies (Clare plan excellent)
- Formation of Community Energy Co-operatives
- Economic recovery for the West of Ireland – new income
- Stable power pricing for business and industry
- Strong support of existing and new FDI – Carbon Free, Price Stable
- Stem emigration and loss of talent
- Reduced emissions – meet International Targets
- Energy security
- Stimulate the economy
- Restore confidence

National Benefits

- NHE would aid Ireland in reaching its **2020 renewable targets**
- NHE would see Ireland shift from being an energy importer, dependent on fossil fuels, to being an **energy exporter**, leading the international market in renewables
- NHE would present Ireland as innovators and **global leaders in renewable energy**
- NHE is completely consistent with and strengthens the Government's Framework for **Sustainable Economic Renewal**, which places energy policy at the heart of the country's programme for recovery
- NHE would enable Government to drive **job creation** in new sectoral areas and in less developed areas of the country

National Benefits

- NHE would represent an opportunity for the Government to embed **semi-state organisations** in Ireland's energy future
- NHE would deliver huge **tax revenues** to the State
- NHE would drive further **Foreign Direct Investment** into Ireland, on the back of the initial Phase One €3.5 billion investment
- NHE has the potential to **lower the cost of borrowing** for Ireland
- NHE would improve Ireland's **international standing** and reputation
- NHE would represent a **legacy project**, the benefits of which would be felt by generations to come
- NHE would generate huge **national pride and optimism**